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Online Neuroanatomy Education and Its Role During the Coronavirus Disease 2019 (COVID-19) Lockdown

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The global response to the coronavirus disease 2019 (COVID-19) pandemic has resulted in widespread changes in our society. To encourage social distancing, schools and universities in the United Kingdom have now closed. The impact this change will have on medical education is unprecedented. The response from the anatomy education community is to move teaching activities online and switch to a full distance-learning paradigm to maintain education during these times. Another key change at many institutions is the switch toward formative end-of-year examinations, with all students progressing regardless of attainment.

Neuroanatomy has long been a scourge of medical students, with the intricate structures, 3-dimensional relationships, and difficult clinical integration cited among the potential causes. In the absence of contact teaching with faculty (e.g., lectures, dissection room) and the removal of extrinsic motivators such as examinations, it is easy to see how undergraduate neuroanatomy education is particularly vulnerable in the time of the COVID-19 lockdown. To minimize the negative impact, we need to provide neuroanatomy resources that are easily accessible, promote an intrinsic interest, and are underpinned by appropriate pedagogy for having a positive impact on knowledge. It is through intrinsic interest that students will continue to self-study during prolonged periods of isolation without summative examinations.

Online learning platforms are already used by many universities to supplement their students' learning in neuroanatomy and to broaden their exposure to educational resources. Blended learning describes the integration of technology-enhanced learning with more traditional approaches in education, such as lectures, practicals, and seminars. Online platforms now have a wide range of functionality and can host live lectures or create breakrooms for small group discussions. They can also host interactive material such as short quizzes or patient-based case studies. Alternatively, they can function as an organized repository for prerecorded content such as videos/animations and screencasts that are configured as playlists and mini-courses.

Online learning allows medical students the flexibility and choice to conduct their self-directed learning at home at times convenient to them. It also allows medical students to control how much time to spend on a subject, which both prevents information overload and allows them to devote more time to areas in which they struggle. It is important that the instructional design of screencasts and video resources align with the principles of the cognitive theory of multimedia learning to minimize cognitive load. Cognitive load is the strain placed on an individual's working memory when processing information for learning and is particularly important in an information-rich subject like neuroanatomy. Therefore, its consideration is essential if online resources are to be effective in increasing knowledge gain and maintaining student engagement.

At the University of Southampton, we have hosted the SotonBrainHub website with its associated YouTube channel and Instagram account since 2014. This contains animated videos on neuroanatomy, head and neck anatomy, cranial nerve examination videos, and recorded lectures. The SotonBrainHub YouTube channel received 69,000 views in April 2020, which is a 61% increase compared with the monthly average in 2019. It serves as an example to demonstrate the current increased demand for online undergraduate neuroanatomy resources at this time. Despite SotonBrainHub being a UK-based initiative, it has an international following, with only 5% of the video viewings coming from the United Kingdom and 21% of the viewings, the highest for any single country, coming from the United States.

There are various ways that online learning can be structured and deployed. Broadly, the online platform can be designed as a full re-creation of the curriculum or as a supplement to other prescribed activities. A full online curriculum provides structured learning and allows students to measure progress and set goals, which is an important element in intrinsic motivation. The disadvantage of re-creating an entire curriculum worth of online activities is that it requires time and planning not afforded by this emergency situation.

Other methods for promoting intrinsic interest through online platforms include case studies and gamification. Patient-based case studies motivate learning by reminding the student of the value and relevance that learning neuroanatomy will have in their future career. They also lift the student up to the *application* level of Bloom's learning taxonomy and in doing so avert one criticism of online learning, which is the tendency of gravitation toward surface-learning approaches. Gamification of learning through online quizzes and peer competition also would build intrinsic motivation to study neuroanatomy and can be performed through applications such as Vevox, which has recently incorporated a new leader board function.

In conclusion, the current COVID-19 lockdown has generated a unique challenge for undergraduate neuroanatomy educators. Online learning approaches, however they are structured, can be a versatile way to keep medical students engaged in their learning. The SotonBrainHub demonstrates that the increased demand for online neuroanatomy resources is a reality and that we should be trying to meet the needs of our students through online resource development in these challenging times. The role of the educator is to consult the relevant pedagogy to ensure online learning tools are well equipped to provide students a clear learning path through the curriculum.